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SOME VALUES OF DEATH STATISTICS.[1]

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GENERAL REMARKS.

THE chief purpose of statistics is to provide accurate information of the values of facts. Individual facts form the groundwork of statistics, and for statistics of any one series of facts to be correct, the facts themselves must be of like kind: want of similarity between facts precludes the possibility of accuracy of statistics in respect of them as a class. When facts are similar and sufficient in number, statistics with regard to them are possible, and though these statistics may not lead to indications of great value, yet because they are true they are valuable in themselves.

So far as the title of this paper is concerned, it refers to a class of statistics that at first thought must seem to be more free from error than many referring to other conditions of life, since the fact of death must be certain. But in the course of the paper it will be seen that however true this fact may be, there is great risk under many circumstances of statistics of mortalities being mis-read and their values misunderstood.

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[1] A Paper read at the Wordsworth Institute, Cockermouth, January 3, 1887.

WEEKLY DEATH RETURNS.

At the last meeting of the British Medical Association, the President of the Public Health Section—Dr. Taaffe—referred in his opening address[1] to the way in which the Registrar-General's weekly returns of births and deaths in London and twenty-seven other great towns in this country are mis-read. I had no idea that they were frequently mis-read, but, under the circumstances, perhaps I may be forgiven for referring to these weekly returns here.

It may be supposed that a town is recorded as having had a weekly death-rate from all causes of 21·3 per 1,000 of the estimated population, and that the population is about 70,000. This statement does not mean that during the week there were in that town 1,490 deaths from all causes; nor with a mortality from fever of 2·2 per 1,000 of population for the same period does it mean that 150 persons died of febrile diseases. What these death-rates do mean is, that if the number of deaths and the population week by week throughout the year remained the same, those would be the gross annual death-rates from all causes and from fevers.

As a matter of fact the number of deaths in this case from all causes during this particular week would be 30, and from fever only 3.

Of course it is quite understood now that the foregoing calculations are the annual death-rates for a single week only, and that if the same rates were maintained week by week throughout the whole year they would be the actual mean death-rates for every thousand of the population at the end of the year. But it stands to reason that the rates may be very different in previous and succeeding weeks from those now taken for the one week, and it is the mean only of all these rates for all the weeks of the year, which tallies with the rate calculated from the total number of deaths at the end of the year.

The method by which the weekly death-rate—in terms of an annual death-rate—is calculated, is to divide the total population by 52·17747—the number of weeks in the exact year—

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[1] *British Medical Journal*, vol. ii. 1886, p. 317.

and with the quotient thus obtained to divide the product of the actual weekly deaths multiplied by 1,000. Thus, in the imaginary case which I have taken, 70,000 ÷ 52·17747 = 1341·5 and 30 × 1,000 ÷ 1341·5 = 21·3 the weekly annual death-rate from all causes, and 3 × 1,000 ÷ 1341·5 = 2·2 the weekly annual death-rate from fever.

Now as to the value of this calculation of a week's mortality in terms of an annual death-rate. First, it shows what the relative mortality of one week is as compared with others that precede or follow it; secondly, it is useful in showing where the variations have been in a total quarterly mortality; and, thirdly, it shows at the end of a year where the variations have been greatest when the quarterly death-rates show marked differences in their proportions to the mean death-rate for the whole year; and it shows all these things at once, because all the rates for weeks, for quarters, and for the year, are calculated to the same annual death-rate values. But of all things in the world, the weekly rate ought not to be taken as a direct indication of the health or otherwise of towns in a particular week, as they often are by the public when these rates appear as reprints in the daily papers, nor ought the public in its estimates of the values of death-statistics to venture to accept these weekly-returns as direct indications of the healthiness of one town over another. For, quite apart from accidental perturbating conditions, which undoubtedly often cause considerable variations in weekly mortality returns, the value of the death-rate from all causes is as nothing unless the full proportion, and rate per 1,000 of population, of deaths from the zymotic diseases are completely reckoned and stated. It may be useful to consider these matters in greater detail; but, before proceeding, it may be well to say with regard to weekly death-rates that they cannot be usefully made in localities where the population is not large, say, where the population is under 50,000 persons. If they are made, I am sure that they ought not, at present at any rate, to be published weekly in local prints, for with the great liability to immense variations in the weekly mortalities of small communities, there will come the danger of adverse rates being quoted by mischievous persons to the detriment of localities, and silly conclusions being propounded by persons with opposite desires.

VALUE OF DEATH STATISTICS AS INDICATORS OF THE HEALTHINESS OF LOCALITIES.

A death-rate in a large town, equally with a small one, for one or more weeks may be unusually high; but no one could suppose that if the chief proportion of that rate were made up of the deaths of persons of old age that the rate would have anything like the same significance as if it were chiefly composed of the deaths of infants; nor would any one imagine the unusually high death-rate from ordinary non-infectious causes of deaths to be a more serious indication of the ill-health of a town, village, or district, than would be a small death-rate chiefly composed of deaths from infectious diseases. Yet the appearances in the press of statements of the exceptional healthiness of places merely on the strength of weekly, quarterly, and annual death returns are not uncommon, and are as frequently read by many persons as expressing the safety of living in those places rather than in others where the total death-rates may happen to be higher.

For death-rates to be read aright, many concurrent facts—local as well as general—ought to be stated at the same time, so that the correct values of the rates themselves may be estimated. Among these facts, not the least important are the two already alluded to,—the ages at which the deaths have occurred, and the kind and proportional fatality of the diseases which have effected the mortality. I may take an example from a town in my own district to show the importance of these factors, and for the purposes of this paper only I take a marked one.

TABLE I.

THE MORTALITY IN KENDAL FOR THE TWO YEARS 1872 AND 1885.

Years.	Annual rate of mortality per 1000 of population from		Percentage to Total Deaths, of Deaths				
	All causes.	Seven principal Zymotic Diseases.	of Infants under 1 year of age.	of Persons over 60 years of age.	from seven principal Zymotic Diseases.	from Lung Diseases, and Phthisis.	from Heart Disease.
1872	19·0	2·0	23·5	31·1	10·4	23·8	6·5
1885	18·5	1·2	23·5	28·9	6·6	29·6	12·5

For the purpose in hand, the comparison of these two years will do particularly well. The annual death-rate per 1,000 of population from "all causes" in each year is apparently nearly the same, the percentage of the deaths to the total deaths at each extreme of life in each year is not widely different, and with these facts before the ordinary reader, it would not be difficult for him to suppose that the years tallied very nearly in respect of healthiness in the town. But a little further examination will show that the amount of risk of infection from zymotic diseases was probably greater in one year than in the other. As a matter of fact, this was so, for there were 27 deaths from zymotic diseases in 1872—2 from small-pox, 1 from measles, 12 from whooping-cough, 7 from enteric fever, 3 from other ill-defined continued fevers, and 2 from diarrhœa; while there were only 17 in 1885—2 from measles, 1 from diphtheria, 11 from whooping-cough, and 3 from diarrhœa. I have purposely taken these two years because in each of them there was an epidemic of whooping-cough giving nearly the same mortality, as well as a considerable prevalence of measles; but there is another point to be considered in reference to the greater risk of infection in the one year than in the other.

The population of the town has increased, speaking roughly, from 13,500 in 1872 to 13,800 in 1885, an increase of only 300 it is true, but still an increase in a small place and not a decrease of population. It follows that with a total of deaths less by 4 in 1885 than in 1872, the risk to life generally in 1872 was probably greater than in the other year; and, as I have also shown that there was an increased mortality in 1872 from zymotic diseases, if the same amount of risk from these had existed in 1885, the total of deaths in this year from them should have been over 27 instead of only 17. Thus, then, though there does not seem to be much difference in the total death-rates of the two years, there really was probably a considerable difference in the indications of comparative safety for life in the town during the two years.[1]

I may allude to one other point in Table I. The proportion of deaths from lung diseases, phthisis, and heart disease in 1885 was very high—higher indeed than the average—and I must say in reference to this fact that the ratios were increased by the severity of the winter months at each end of the year. It so happens that the mean annual temperature of the air in the two years corresponds with the difference; but because it is a mean annual temperature, and the monthly or weekly deaths are not compared with the mean monthly or weekly temperatures of the air, this concurrence ought not to be held as having more than a possible relation to the mortality. The mean annual temperature of the air for 1872 was 49·81 degrees, in 1885 it was 45·36 degrees, Fahrenheit.

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[1] It may be noted that the later year *was under the influence of the Public Health Act*, 1875, and had the further advantage over the other of an infectious diseases hospital.

Thus the reading of death-returns may be fallacious in the absence of details affecting them, and, unless such be given, no one is justified in at once coming to the conclusion that the death-rate from all causes can be accepted as an indicator that a place is exceptionally free from risk to life, or otherwise, for those who live in it. But as death-returns in a crude state are often read and referred to by persons who meditate spending their summer vacations away from home, I will take an example to illustrate the folly of so doing, from a summer resort also within my district.

It is a small urban sanitary district, having an area of about 100 acres, and a resident population during 1884 and 1885 of about 1,350 persons of all ages, and I may say further, that a house-to-house inspection, which I had initiated about the time, had not resulted in the discovery of a large number of grave sanitary defects inimical to health.

In the earlier year the total number of deaths was 12, giving an annual death-rate of 9·0 per 1,000 of the resident population, in the later year the deaths were 32, or at the rate of 23·7 per 1,000 of the resident population. In neither year was there a single death among temporary visitors. If these death-rates were to be taken without other facts, it might surprise some to be told that there was no more danger or risk in the one year to spend the summer in the place than there was in the other year.

In the first place, the two death-rates were exceptional; in the second, neither year gave a mortality from grave zymotic disease; in the third, the increased number of deaths in 1885 was probably due to fatality from lung diseases during the severity of the winter months, and partly to an infantile mortality of an exceptional kind. The estimation of the proportions of the deaths at particular ages is in such an instance as this particularly desirable.

TABLE II.

PERCENTAGE OF DEATHS TO THE TOTAL DEATHS.

Years.	Under 1 year.	Between 1 & 5 years.	Between 5 & 15 years.	Between 15 & 25 years.	Between 25 & 60 years.	Over 60 years.
1884	8·3	8·3	16·6	8·3	24·9	33·2
1885	24·8	12·4	3·1	...	18·6	40·3

This table at once shows that though the sum of the percentages of deaths in each year from 25 to over 60 years of age had practically the same ratio, yet the infant mortality was higher in 1885 than in 1884, and particularly so as regards infants under one year of age.

The explanation of this fact is, that several infants died from inanition within an hour of their birth, and their deaths had to be registered because they were born alive. In a large town or district this feature, which had not occurred in 1884 in the place of which I am speaking, would have been submerged in a large total of deaths; but coming as it did in a small place, it not only became a prominent feature in itself, but it also gave an abnormal appearance to the total death-rate for 1885. It was a fact which had no direct connexion with the reputation for salubrity of the place as a summer resort, and was accidental rather than special.

Before proceeding any further, I would like to make one observation in respect of the useful examination of death statistics, or indeed any other class of statistics, for sanitary purposes. They must be comparative; for if we did not compare statistics of the same community for different periods, or statistics of different communities for a particular time, we should learn nothing of these communities that would be good or useful, nor could we, if statistics were not in the strictest sense things to be submitted to comparison, say what was bad, nor under varying conditions what might be taken as a general standard or average. So far as the small district of which I have been speaking is concerned, I have figures of mortality from 1877 only, and since that year the number of houses within its area has increased from 171 to 265. It is not possible in this case to estimate to any useful extent from its death-statistics, what values differences in the mean death-rates, in the absence of grave epidemics of zymotic diseases, may have in respect of the health-repute of the district. But the town of Kendal to which I have before referred does yield statistics for a considerable area and for a length of time that make their values in a large degree manifest at first sight, and in speaking of these in the next division of this paper, it is particularly desirable that the idea of comparison of statistics should predominate, or else the mere detailing of figures will be of very little use. It may also be useful to note the slow progress in the increase of population in the town for a period of 45 years as shown in the following table:

TABLE III.

MUNICIPAL BOROUGH OF KENDAL.

Years.	Area in Acres.	Inhabited Houses.	Average number of persons in each house.	Total Population.	Increase of the population in ten-year periods.
1841	2,622	...	...	11,770	(from 1831) 159
1851	2,622	...	...	11,829	(from 1841) 59
1861	2,622	2,590	4·6	12,029	(from 1851) 200
1871	2,622	2,727	4·9	13,446	(from 1861) 1,417
1881	2,622	2,807	4·8	13,696	(from 1871) 250
1885	2,622	2,848	4·8	13,800	(from 1881) 104

VALUE OF DEATH STATISTICS AS INDICATORS OF SUCCESSFUL SANITARY ACTION.

The mortalities for convenience being taken in five-year periods, it will be seen from the next table that the total mortality in the town has decreased considerably—the mean annual decrease of deaths in forty-five years, account being taken of the increase of population as shown in Table III., being about ten for every 1,000 persons living. So far we learn something from the death-rates from "all causes"; but unless it is shown what kind of diseases the population runs less risk of now than it did, this bare fact can only give partial satisfaction.

TABLE IV.

BOROUGH OF KENDAL.

Table of mean Death-rates from all causes, from Phthisis, and from Infectious Diseases in five-year periods from 1841—1885.

	Mean Total Deaths from			Mean annual rate of mortality per 1000, from			Mean percentage to total deaths of deaths from		Mean Total Deaths from								
5-year Periods.	All causes.	Phthisis.	Seven principal zymotic diseases.	All causes.	Phthisis.	Seven principal zymotic diseases.	Phthisis.	Seven principal zymotic diseases.	Small-pox.	Measles.	Scarlet-fever.	Diphtheria.	Whooping-cough.	Typhus-fever.	Typhoid-fever or Enteric-fever.	Other fevers.	Diarrhœa and Dysentery.
1841—45	292·6	49·6	34·0	24·8	4·2	2·9	17·0	11·4	7·4	5·4	2·4	...	2·8	8·8	...	4·6	2·6
1846—50	330·4	44·8	69·2	28·0	3·8	4·2	13·2	13·7	1·4	2·8	14·2	...	1·6	17·0	...	6·4	5·8
1851—55	269·0	34·6	44·2	22·5	2·9	3·7	12·1	16·1	2·4	8·0	18·0	...	2·6	6·2	...	2·4	4·6
1856—60	251·2	35·2	25·6	20·8	2·9	2·1	14·0	9·5	1·6	7·4	2·0	...	4·2	6·6	1·0	1·8	1·0
1861—65	276·6	32·6	29·2	22·4	2·6	2·4	11·8	10·0	·2	3·2	11·2	·2	3·4	3·0	·8	2·0	5·2
1866—70	293·2	37·8	38·8	22·4	2·9	2·9	12·9	12·8	...	9·4	13·2	·4	4·4	1·8	1·8	1·4	6·4
1871—75	272·0	25·4	25·4	19 7	2·1	1·6	10·5	7·9	·4	3·6	1·4	2·0	6·6	...	3·4	1·2	3·4
1876—80	275·0	33·0	30·2	19·3	2·7	2·1	11·4	10·1	·8	7·0	12·4	·2	3·0	...	2·8	...	4·0
1881—85	260·2	36·8	21·4	18·9	2·6	1·5	14·2	8·1	·2	3·4	2·2	1.4	2·8	...	5·8	...	5·6

From this table it will be seen that the mean annual rate of mortality from infectious diseases per 1,000 of population has reached a lower point in the last quinquennium than in any other like period since the passing of the Registration Act in 1837; the percentage of these deaths to the total deaths is also lower than it used to be, though not so much so as it might be expected to be. This last point is just one of those whence a faulty impression might be derived. There is no question that the risk of infection in the town has been enormously lessened since the passing of the Public Health Act of 1875, and I suppose it is less at the present time than it ever has been, and unless a careful examination be made of the mortalities for each of the five years 1881-85, the general indication of the mean rate for the whole period might well be a misleading one. I therefore add the following table for these separate years :—

TABLE V.

Table of Death rates in the five years 1881—85, *on the plan of Table IV.*

	Total Deaths from			Annual rate of mortality per 1,000 from			Percentage to total deaths of deaths from		Total Deaths from								
Years.	All causes.	Phthisis.	Seven principal zymotic diseases.	All causes.	Phthisis.	Seven principal zymotic diseases.	Phthisis.	Seven principal zymotic diseases.	Small-pox.	Measles.	Scarlet fever.	Diphtheria.	Whooping cough.	Typhus-fever.	Enteric-fever.	Other fevers.	Diarrhœa and Dysentery.
1881	255	29	15	18·6	2·1	1·0	11·7	5·8	1	1	6	3	...	...	3	...	1
1882	265	34	17	19·3	2·4	1·2	12·8	6·4	...	1	5	2	1	...	5	...	3
1883	253	42	16	18·4	3·0	1·1	16·6	6·3	...	4	...	...	2	...	2	...	8
1884	272	43	42	19·7	3·1	3·0	15·8	15·4	...	9	...	1	...	...	19	...	13
1885	256	36	17	18·5	2·6	1·2	14·0	6·6	...	2	...	1	11	...	...	...	3

It will be seen at once from this table which year especially contributed, and exceptionally so, to raise the mean rate for this quinquennial period—1884. From three diseases the mortality was largely above the average for many years, and, though I need not now refer in detail to the chief causes of these mortalities, it will suffice for the credit of the town to say that the causes leading to the epidemic of enteric fever were immediately and permanently removed when they were discovered. The year's mortality was exceptional, it is not likely to be so exceptionally repeated, and the table plainly shows why the quinquennial mean percentage mortality for 1881—85 (Table IV.), was not so low as it might have been, if there had been no operation of exceptional circumstances in a particular year.

Still, in spite of the severity of the test, the mean annual mortality rate from zymotic diseases is plainly less than it has been for many years past. Small-pox has almost ceased to give mortality, there was only one death in the last quinquennium ; measles, in spite of two epidemics in the last quinquennium, has not increased the mortality-rate above the average ; the deaths from scarlet-fever have enormously decreased in number, so to some extent have those from whooping-cough, although there was an epidemic in 1885. What do these things mean? The last three are diseases principally of childhood, and we learn that, in spite of epidemics which cannot be prevented from occurring, the chances of recovery from disease are improved and the risks of personal infection are lessened.

But before stating what the sanitary improvements are, which have had so much to do with reductions in the zymotic death-rates in Kendal, it may be well just to show by figures how great is the fact of decrease in the continued-fever mortality,—a mortality from diseases the causes of which more than all others are amenable to sanitary improvements,—in ten-year periods, in Kendal from 1842—1881.

MEAN ANNUAL MORTALITY.

1st decade	1·588	per 1,000 of population.
2nd decade	0·701	,, ,, ,, ,,
3rd decade	0·415	,, ,, ,, ,,
4th decade	0·261	,, ,, ,, ,,

And further, the general decline in mortality, from zymotic diseases through the whole of this country as evidence of the efficacy of sanitary administration, careful sewerage, better water supply, and other sanitary improvements, may be seen from the Registrar-General's recent death-returns. The annual deaths from scarlet-fever per million of population have fallen from 972 to 716, from measles, from 440 to 371, and from the continued-fevers, from 885 to 484.

In 1849 a report on the sanitary condition of Kendal by a Superintending Inspector of the General Board of Health disclosed a condition of filth difficult to understand now. From the end of 1850, Table IV. shows a decline in mortality from zymotic diseases. What then has been done?

1. A water-supply, gathered from the adjacent hills into reservoirs, was made available for the town through the energy and enterprise of a private company in 1849. This did not, however, come into general use for some time after, and was not apparently laid on to all houses in 1861. Still, at a later date,

the distribution was fairly general, and since then has become practically universal.

2. In 1849 and for years previously, the chief drainage of the town appears to have been direct into the river, which being liable to sudden changes in its volume, and therefore often leaving a large portion of its channel dry, no doubt formerly contributed to an abominable nuisance. Some of the old sewers were merely open ditches, through which the flow of sewage was not always rapid, and soakage from them into the surrounding soil undoubtedly occurred. This system was brought to an end by the completion of main-sewerage works, which first came into general use in the beginning of 1874.

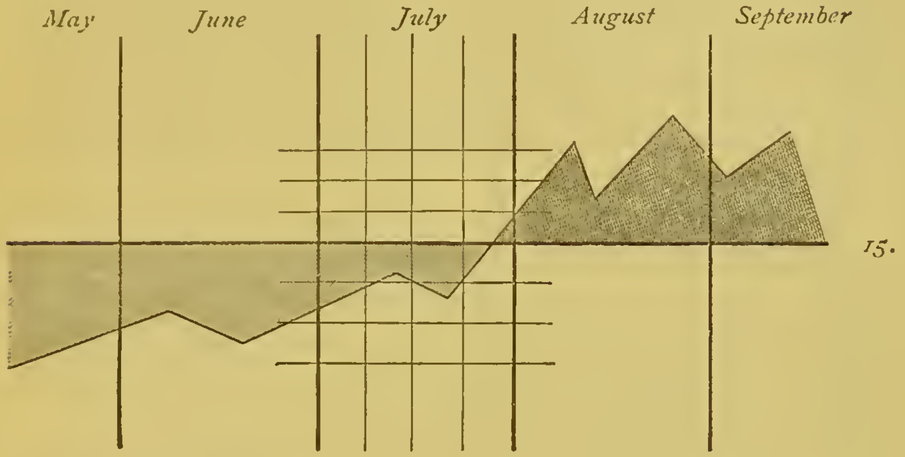
3. Since 1880 the removal of refuse and midden-contents has been undertaken by the sanitary authority itself, and these things are not now left to the mere convenience or spasmodic energy of tenants or landlords.

4. In 1882 a small hospital for the immediate isolation of cases of infectious diseases was built by the Sanitary Authority, and the beneficial influence of this institution has been felt on more than one occasion in each succeeding year, with results, so far as scarlet fever and small-pox are concerned, of a nature that Table V. shows to be most encouraging and satisfactory.

Is there not here evidence of the value of death-statistics as indicators of the advancement for good of sanitary science?

VALUE OF DEATH STATISTICS AS INDICATORS OF THE PREVALENCE OF DISEASES IN SEASONS.

With respect to this value, workers in sanitary science have accomplished some definite evidences of utility, although in all probability those which have been found will prove to be but the forerunners of much larger and more extensive calculations as to the periodicity of disease. At first sight this fresh consideration of the subject may not seem to be very clear or its usefulness very apparent; but an example may suffice to show how the comparison of deaths with time may give valuable indications of the possible prevalence of particular diseases at particular periods. The following diagram may serve to assist my explanation:—



In this diagram the dark horizontal line will represent the mean average number of deaths—for example, fifteen—from a particular disease throughout each week or month of a year, or series of years; the finer horizontal lines above and below the average line (represented in the month of July) may be taken to represent percentage deviations above or below, respectively, the mean average number of deaths in each week or month. The dark vertical lines represent the divisions of the months of the year, the finer vertical lines the divisions of the weeks. A chart might be prepared which only showed the deaths *per mensem*, and with a small mean average monthly number this would be better, so as to avoid possible error, than to show the deaths for each week.

Now, if the total deaths of a particular disease in a given locality during a number of years—for example, ten years—gave a particular curve on a chart prepared on the principle of this diagram, and curves for other localities in like manner, and for the same disease, were also obtained without remarkable deviations in their *contour*, the result would be to establish the fact of a greater and more regular prevalence of this particular disease in a particular season. Such charts have been prepared from time to time, and one apparently especially free from error has lately been prepared for typhus fever, simple continued-fever, and enteric fever.[1] I am speaking now only of deaths; but when we speak of the prevalence of a disease, it necessarily follows that this must begin to occur before the advent of the deaths, and if, as in the work to which I have just referred, a very large number of admissions into large hospitals for a number of years can be obtained, a more accurate curve of the actual usual period of prevalence can be drawn.

But where is the great value of all this? Let me only refer to one disease in connexion with this question, and I will answer. Already I have referred to enteric fever as being eminently a filth disease, one, therefore, which should be a preventable disease. If we know, then, thus definitely in the absence of unusual disturbing causes, when the time is that this disease is liable to have an increased prevalence over all other times of the year, it teaches sanitary officials to be more than ordinarily watchful at such a time, to take more than ordinary precautions against the accumulation of filth and its retention in unsuitable localities, to be more alert against the disposition of infectious matters from the patients to the risk of others.

These are things of no small value. There is no complete registration of sickness in this country; there is, on the other hand, registration of death; and imperfect as this may be, the amount of error in it may often be surmounted, and very useful results may be thence obtained.

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[1] "The Seasonal Prevalence of Continued Fevers in London," by G. B. Longstaff, M.A., M.B. *Transactions of the Epidemiological Society of London.* N. S. vol. iv. 1884-85, pp. 72-86.